

Micro Plasma Spectrometer (MIPS)

Completed Technology Project (2013 - 2014)



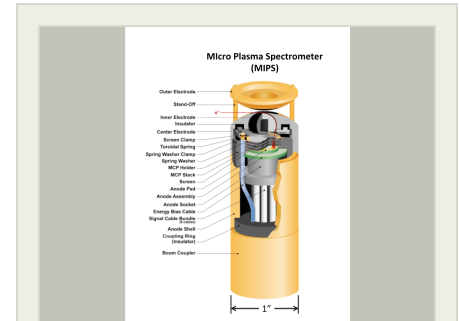
Project Introduction

The purpose of this IRAD project is to develop a preliminary design elements of miniature electron and ion plasma spectrometers and supporting electronics, focusing on early high voltage power supply (HVPS) development and innovative mechanical design and fabrication techniques based on 'additive manufacturing'. On the HVPS side, clear, simple, and conservative requirements that don't attempt to push performance envelopes will be key to our ability to conceive and prototype a minimum resource solution. This development targets future opportunities for application on Cube-Sats and other low resource Heliophysics payloads, including sounding rockets, Explorers, particularly, constellation missions.

The need for electrostatic analyzers to measure ion and electron fluxes in near-Earth space is nearly ubiquitous in Heliophysics missions. In the latest example, NASA's MMS mission slated for launch in 2014 features fully 32 electron and 32 ion spectrometers. These plasma measurements are central to the vast majority of such missions. The range of fluxes and energies to be covered is extremely wide, in view of the wide range of plasma conditions across the heliophysics realm. The GSFC Heliophysics Division enjoys a distinguished tradition of developing and flying these devices and is well placed to provide future leadership in this area.

Two specific and related thrusts within the field demand the development of minimum resource instrument work horses for future missions. Those are constellation missions and the development and proliferation of Cube-sats. The Cube-sats themselves may well comprise the elements of future constellations. Constellations, or groups of spacecraft providing networks of observation points, have been called for in both the current and past HPD roadmaps. Early, small number constellations have been realized with NASA's Themis mission (5 sc) and ESA's Cluster mission (4 sc). MMS itself is comprised of 4 sc. Future mission concepts call for constellations with many more sc. Realization of these concepts will require individual instruments and supporting spacecraft systems with phenomenally small physical resource requirements. Progress is being made quickly on the spacecraft system side, with lots of innovation evident in Cube-sat architectures, subsystems, and deployment systems. **The time to focus on resource minimization for work horse instruments is now!**

The overarching goal of this IRAD is to exploit the definition of clear simple and non-exceptional performance requirements with innovative design and fabrication techniques and, perhaps, a relatively high risk tolerance, to develop an ESA package design that will feature basic functionality over a wide range of energies and fluxes, with minimum physical resource requirements and a high level of manufacturability. We will pursue this goal by developing a package concept that can fit and operate in a 1U x 1U Cube-sat. Specific objectives of this first development year include:



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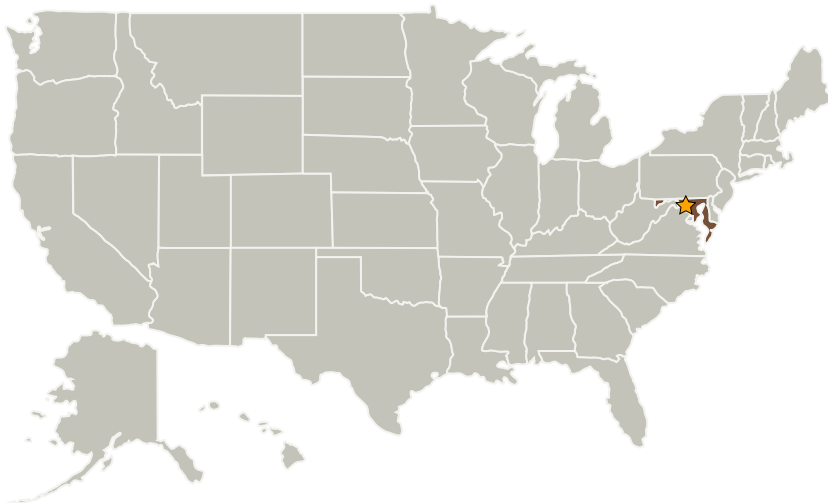
- Define minimalist science requirements for a low-resource, workhorse class ESA package for HPD missions that meet objectives in the proposed DIONE Cube-sat mission.
- Flow these down to a correspondingly minimalist set of HVPS requirements.
- Design, develop, and demonstrate a prototype HVPS that meets defined requirements and fits within the volumetric envelope available in the proposed DIONE payload.
- Perform a conceptual ion & electron ESA package design, based on a 1" dia. MCP.

Conduct a feasibility study on use of additive manufacturing technology (3D printing) in manufacturing small, and very light weight miniature ESA and detector assemblies and/or components with sufficient strength and dimensional precision.

Anticipated Benefits

This technology would benefit any mission requiring plasma measurements that have very small availability of physical resources like mass, power, volume. This will be particularly applicable to the CubeSat platform which is coming into more extensive use. This could also benefit future Explorer missions withing Heliophysics Science Division or future low-resource planetary missions.

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

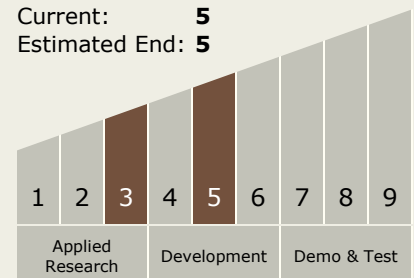
Nikolaos Paschalidis

Principal Investigator:

Craig J Pollock

Technology Maturity (TRL)

Start: 3
Current: 5
Estimated End: 5



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Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Co-Funding Partners	Type	Location
ADNET Systems Inc.	Industry Small Disadvantaged Business (SDB)	
University of Maryland-College Park(UMCP)	Academia	College Park, Maryland

Primary U.S. Work Locations

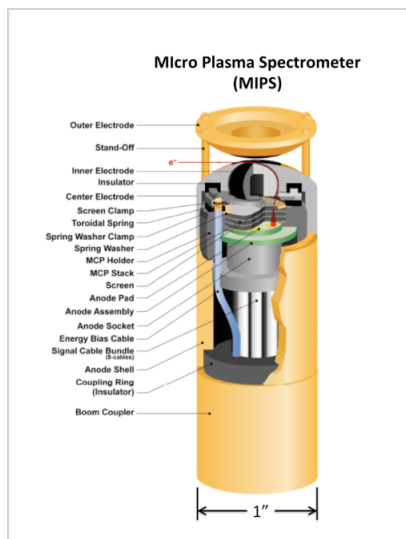
Maryland

Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.3 Thermal Protection Components and Systems
 - └ TX14.3.2 Thermal Protection Systems

Images

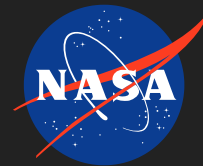


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 (<https://techport.nasa.gov/image/4125>)

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Project Website:

<http://sciences.gsfc.nasa.gov/sed/>